

several apparently endemic species have been found here. The name of *R. kosnipatana* refers to its collection locality.

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#### Literature Cited

- Delprete, P. G. 1999. *Rondeletiae* (Rubiaceae)—Part I. Fl. Neotrop. Monogr. 77. New York Botanical Garden Press, Bronx.
- Huamantupa Chuquimaco, I. 2005. *Vochysia kosnipatae* (Vochysiaceae), una nueva especie endémica en el Pongo de Qoñec, Valle de Kosñipata, Cusco-Perú. *Arnaldoa* 12(1-2): 82-85.
- IUCN. 2001. IUCN Red List Categories and Criteria, Version 3.1. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland, and Cambridge, United Kingdom.
- Persson, C. 2003. *Agouticarpa*, a new neotropical genus of tribe Gardenieae (Rubiaceae). *Brittonia* 55(2): 176-201.
- Puff, C., A. Igersheim, R. Buchner & U. Rohrhofer. 1995. The united stamens of Rubiaceae. Morphology, anatomy; Their role in pollination ecology. *Ann. Missouri Bot. Gard.* 82: 357-382.
- Robbrecht, E. & J.-F. Manen. 2006. The major evolutionary lineages of the coffee family (Rubiaceae, angiosperms). Combined analysis (nDNA and cpDNA) to infer the position of *Coptosapelta* and *Luculia*, and supertree construction based on *rbcL*, *rps16*, *trnL-trnF* and *atpB-rbcL* data. A new classification in two subfamilies, Cinchonoideae and Rubioideae. *Syst. Geogr. Pl.* 76: 85-146.
- Rova, J. H. E., P. G. Delprete, L. Andersson & V. A. Albert. 2002. A *trnL-F* cpDNA sequence study of the Condamineae-Rondeletieae-Sipaneeae complex with implications on the phylogeny of the Rubiaceae. *Amer. J. Bot.* 89(1): 145-159.
- Simpson, D. R. 1976. Studies in neotropical Rubiaceae. I. *Rustia*. *Phytologia* 33(1): 4-8.
- Standley, P. C. 1936. Rubiaceae. Pp. 3-261 in J. F. Macbride (editor), *Flora of Peru*. Field Mus. Nat. Hist., Bot. Ser. 13(6). Field Museum, Chicago.
- Ulloa Ulloa, C., J. L. Zarucchi & B. León. 2004. Diez años de adiciones a la flora del Perú: 1993-2003. *Arnaldoa*, Ed. Esp., 1-242.

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# A New Taxon of *Linum* (Linaceae) from Southwest Anatolia, Turkey

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**ABSTRACT.** A new taxon, *Linum hirsutum* L. subsp. *bozdaghense* Yılmaz & Kaynak (Linaceae), is described from southwestern Anatolia, Turkey. It is similar to *L. hirsutum* subsp. *oreocaricum* P. H. Davis, from which it differs mainly in the shape and indumentum of leaves and in petal color. Diagnostic, morphological, and geographical data are discussed, and a revised key to the subspecies of *L. hirsutum* is given.

**Key words:** IUCN Red List, Linaceae, *Linum*, section *Dasylinum*, Turkey.

The genus *Linum* L. (Linaceae) comprises about 180 species in the temperate regions of the world (Mabberley, 1997). The Mediterranean area is one of the main centers of diversity for *Linum*, with approximately 75 species (Greuter et al., 1989); this diversity is particularly pronounced in the Balkans and Anatolia (Davis, 1967a).

The genus *Linum* has been divided into five sections; of these, section *Dasylinum* (Planch.) Juz. is distributed in central and southern Europe, the Caucasus, and western Asia (Davis, 1957; Ockendon & Walters, 1968; Agnew, 1980; Zohary, 1987). This section is one of the more easily recognizable groups within *Linum* and is distinguished by its characteristic indumentum on the entire plant consisting of hirsute or villous, unicellular trichomes. Section *Dasylinum* comprises about seven species; they are usually perennial herbs (e.g., *L. viscosum* L., *L. hirsutum* L., *L. unguiculatum* P. H. Davis, *L. densiflorum* P. H. Davis, *L. hypericifolium* Salisb., *L. olympicum* Boiss.) or conspicuous annuals (e.g., *L. pubescens* Banks & Sol., *L. seljukorum* P. H. Davis) (Davis, 1967a; Yılmaz & Kaynak, 2008a, b). This section was first established by Planchon (1847) as a series within the subgenus *Syllinum* (Griesb.) Planch. Juzepzhuk (1949) subsequently evaluated this group as a separate section within *Linum*. In this paper, we describe a new subspecies for *L. hirsutum* within section *Dasylinum* from southwestern Anatolia, Turkey.

Flowering specimens of *Linum hirsutum* were collected from Bozdağ Mountain, from Tavas, Denizli Province, Turkey, in June 2007 and 2008. Available

herbarium specimens of *L. hirsutum* were examined from the herbaria ANK, BULU, EGE, GAZI, and K, including the type specimens. For scanning electron microscopy, selected representative materials were coated with gold-palladium for two minutes in a BAL-TEC SCD 005 sputter-coater (Leica Microsystems, Wetzlar, Germany). The micrographs were obtained using an EVO 40 microscope (Carl Zeiss AG, Oberkochen, Germany) at 30 kV.

**1. *Linum hirsutum* L., Sp. Pl. 1: 277. 1753. TYPE:** “Habitat in Austriae, Tatariae edits graminosis,” *Gerber s.n.* (lectotype, designated in Optasyuk & Mosyakin [2006: 525], LINN 396.11 digital image seen).

**1a. *Linum hirsutum* subsp. *hirsutum*.**

**1b. *Linum hirsutum* subsp. *anatolicum* (Boiss.) Hayek, Prodr. Fl. Balc. 1: 564. 1925. Basionym:** *Linum anatolicum* Boiss., Diagn. Pl. Orient., ser. 1, 1: 56. 1843. TYPE: Turkey. Laodicea, 1842, *Boissier s.n.* (type, K digital image seen).

**1c. *Linum hirsutum* subsp. *bozdaghense* Yılmaz & Kaynak, subsp. nov. TYPE:** Turkey. C2 Denizli: Tavas, Büyükkonak (Nikfer), N of Bozdağ Mtn., 1946 m, 37°19'N, 29°10'E, 13 June 2007, Ö. Yılmaz *s.n.* (holotype, BULU 29039). Figure 1.

Haec species *Lino hirsuto* L. subsp. *oreocarico* P. H. Davis similis, sed ab eo foliis oblanceolata-oblongis 4–6 × 0.5–1.5 mm (non 6–9 × 1.5–2 mm) margine haud glandulosis atque petalis pallide azureis ad basim flavis differt.

Herbaceous perennials, arising from an underground woody stock; nonflowering shoots few, flowering stems prostrate, to 10 cm vertically, ca. 0.5 mm thick, pilose. Lower cauline leaves and nonflowering shoot leaves oblanceolate, 2–3 × ca. 0.5 mm, obtuse, glabrous. Median cauline leaves oblanceolate-oblong, attenuate near base, 4–6 × 0.5–1.5 mm, 1-veined, blade without glandular margins, glabrous to sparsely pilose, subacute to obtuse. Flowers 1 to 5 per fertile stem, pedicels 1–2 mm, flowers heterostylic. Sepals lanceolate, 6.5–8.5 × 1.5–2 mm, the outer sepals with

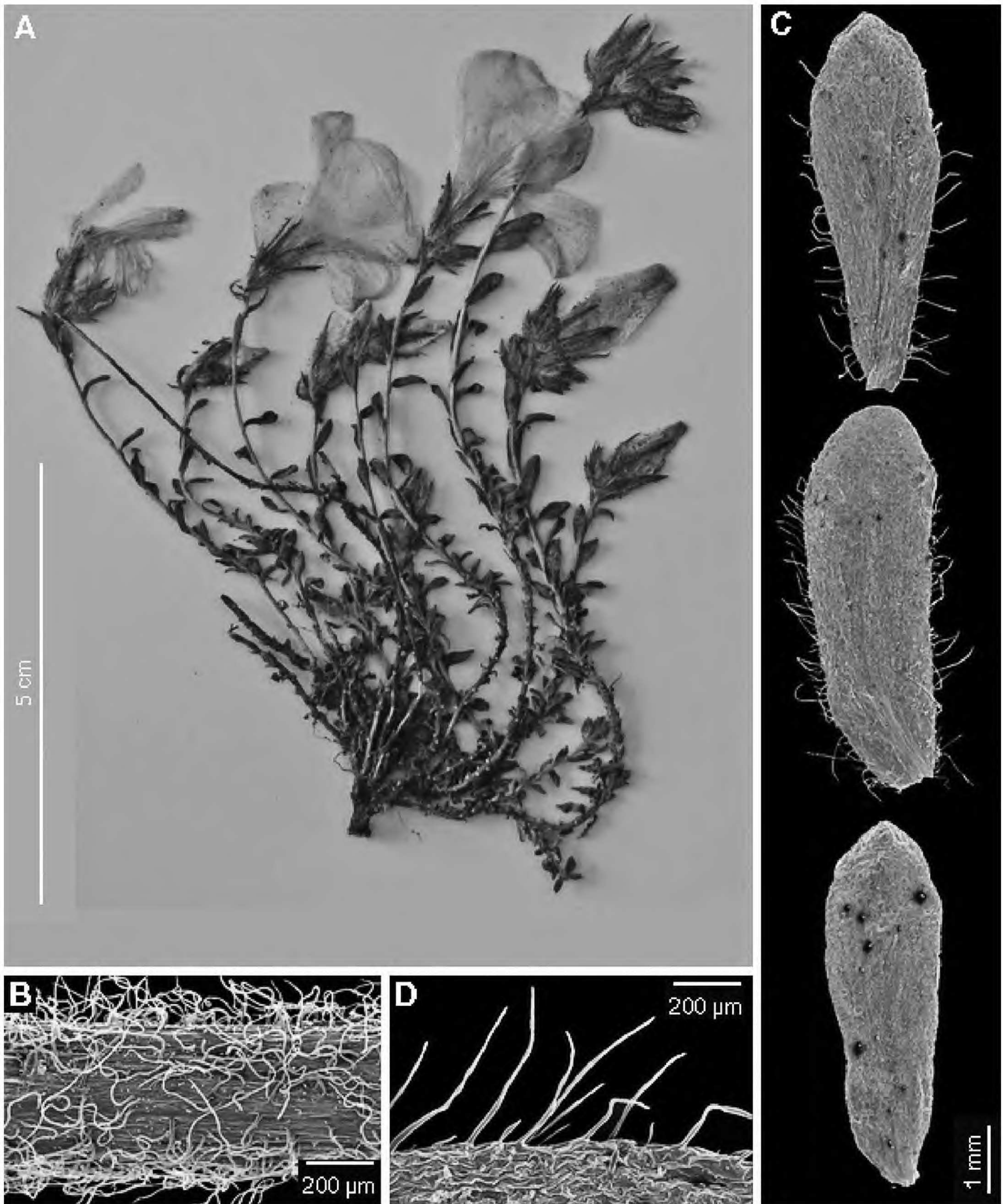


Figure 1. *Linum hirsutum* subsp. *bozdaghense* Yılmaz & Kaynak. —A. Fertile plant habit. B–D. SEM images. —B. Flowering stem. —C. Cauline leaves. —D. Margin of cauline leaves. All images from the holotype Ö. Yılmaz s.n. (BULU 29039).

stalked glands at margins, the inner sepals with scarious margins at base, conspicuously 3-veined, not keeled, densely pilose; petals 17–22 × 7–8 mm, pale blue with yellow base. Capsule unknown.

*Distribution and habitat.* *Linum hirsutum* subsp. *bozdaghense* and *L. hirsutum* subsp. *oreocaricum* are

isolated taxa and of local distributions (Fig. 2). The two subspecies were only found on Bozdağ and Babadağ Mountains, respectively. Both of them grow on calcareous alpine steppes, at altitudes approximately 1900 m above sea level. *Linum hirsutum* subsp. *byzantinum* Azn. is restricted to the European part of Turkey, while *L. hirsutum* subsp. *anatolicum*,

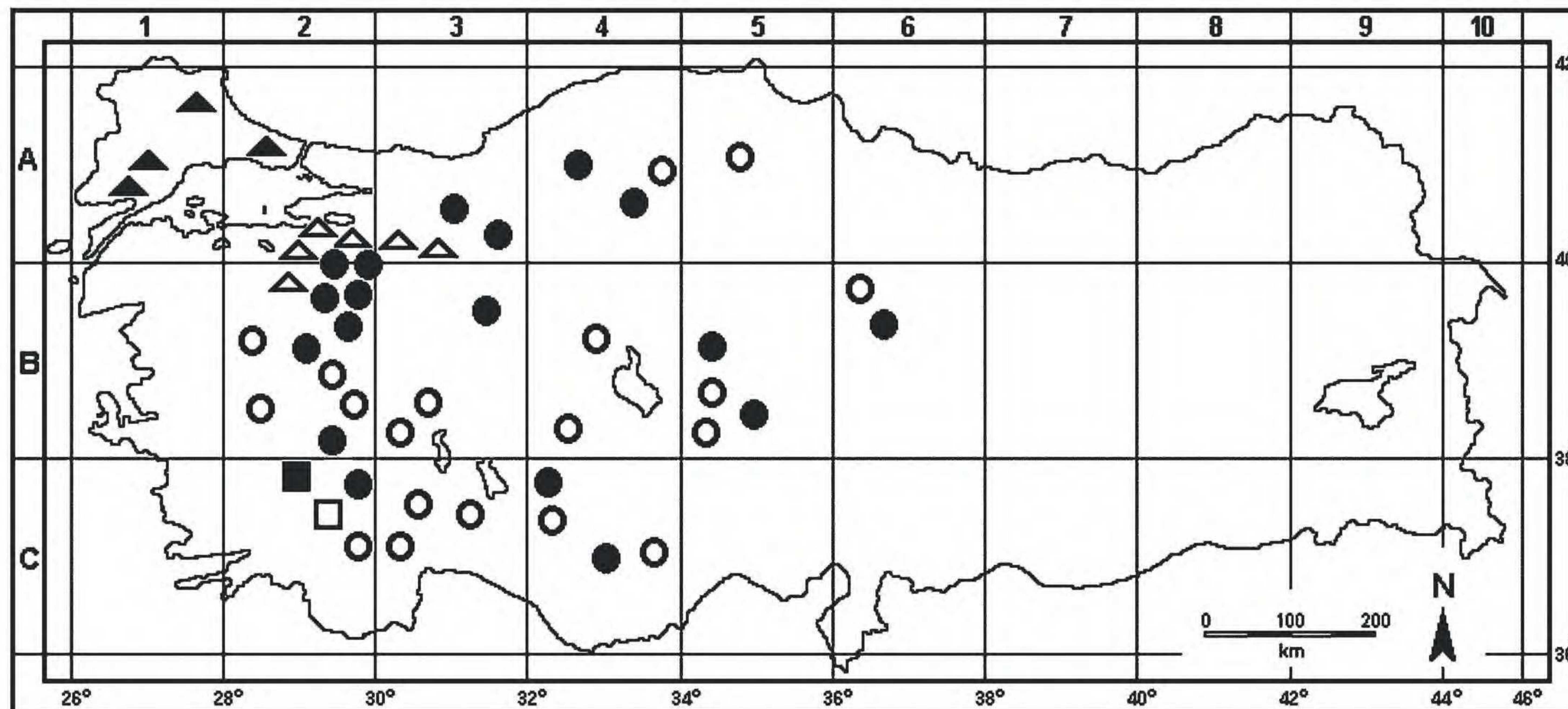


Figure 2. Distributions for subspecies of *Linum hirsutum* L. in Turkey. Filled circle, *L. hirsutum* subsp. *anatolicum*; open square, *L. hirsutum* subsp. *bozdaghense*; filled triangle, *L. hirsutum* subsp. *byzantinum*; filled square, *L. hirsutum* subsp. *oreocaricum*; open triangle, *L. hirsutum* subsp. *platyphyllum*; open circle, *L. hirsutum* subsp. *pseudoanatolicum*.

*L. hirsutum* subsp. *platyphyllum* (P. H. Davis) Yılmaz & Kaynak, and *L. hirsutum* subsp. *pseudoanatolicum* P. H. Davis are distributed in western and central Anatolia. They grow mostly under trees and in forest clearings of *Pinus brutia* Ten. and *P. nigra* J. F. Arnold, fallow fields, rocky places, and calcareous steppes between 200 and 1500 m.

**IUCN Red List category.** *Linum hirsutum* subsp. *bozdaghense* is endemic to southwestern Anatolia and is known from two close localities. The populations consist of approximately 150 individuals. Therefore, the new subspecies is assessed here as Critically Endangered (CR B2) according to IUCN Red List criteria (IUCN, 2001), because the estimated area of occupancy is less than 10 km<sup>2</sup>.

**Phenology.** The new subspecies was collected in flower in June.

**Etymology.** The epithet of the new subspecies refers to the type locality.

**Discussion.** *Linum hirsutum* is a highly polymorphic species represented by many subspecific taxa in Europe and Anatolia (Davis, 1957; Ockendon & Walters, 1968). In Turkey, the taxon is represented by five subspecies (Yılmaz & Kaynak, 2006). All of them, with the exception of *L. hirsutum* subsp. *byzantinum*, are endemic to Anatolia. The stem orientation (erect, ascending, prostrate), leaf shape, presence or absence of glands at the margins of median cauline leaves, the number of flowers per inflorescence, and flower color are used to distinguish the subspecific taxa within *L. hirsutum* (Davis, 1967a, b).

*Linum hirsutum* subsp. *bozdaghense* is similar to *L. hirsutum* subsp. *oreocaricum*. However, the new

subspecies clearly differs by its median cauline leaves that are oblanceolate-oblong (vs. oblong), smaller (4–6 × 0.5–1.5 mm vs. 6–9 × 1.5–2 mm), and with eglandular margins (vs. glandular margins); its flowers numbering one to five per stem (vs. one to three per fertile stem); and its petals that are pale blue with a yellow base (vs. white with a lilac base). The new subspecies is also morphologically close to *L. hirsutum* subsp. *anatolicum*, but subspecies *anatolicum* is distinct by its taller habit (20–50 cm) and ascending flowering stems, oblong-linear and larger median cauline leaves, seven or more flowers per fertile stem, and pale lilac to blue petals.

**Paratype.** TURKEY. **C2 Denizli:** Tavas, Büyükkonak (Nikfer), W of Bozdağ Mtn., 2100 m, 20 June 2008, Ö. Yılmaz s.n. (BULU 32550).

**Id. *Linum hirsutum* subsp. *byzantinum*** Azn., Bull. Soc. Bot. Fr. 46: 140. 1899. TYPE: [Turkey.] “Lieux incultes et secs des collines, près de Beuyuk–Halkale (Büyük Halkalı),” *Aznavour* s.n. (type, G).

**Ie. *Linum hirsutum* subsp. *oreocaricum*** P. H. Davis, Notes Roy. Bot. Gard. Edinburgh 22: 143. 1957. TYPE: [Turkey.] C2 Denizli: Baba Da. above Kadiköy, 2300 m, on limestone scree, 19 June 1938, *Davis* 233 (holotype, K; isotype, E digital image seen).

**If. *Linum hirsutum* subsp. *platyphyllum*** (P. H. Davis) Yılmaz & Kaynak, Ann. Bot. Fenn. 43(1): 62. 2006. Basionym: *Linum hirsutum* L. subsp. *anatolicum* (Boiss.) Hayek var. *platyphyllum* P.

H. Davis, Notes Roy. Bot. Gard. Edinburgh 22(3): 142. 1957. TYPE: Turkey. Keschisch Da., 200 m, 1889, *Bornmüller 4216* (holotype, K digital image seen).

**1g. *Linum hirsutum* subsp. *pseudoanatolicum* P. H. Davis, Notes Roy. Bot. Gard. Edinburgh 28: 38. 1967. TYPE: [Turkey.] Bakir Dag, above Kiske, 1500 m, open slopes by *Pinus nigra* subsp. *pallasiana* forest, 28 June 1952, *Davis 19317*, *Dodds & Çetik* (holotype, E; isotype, K).**

KEY TO THE SUBSPECIES OF *LINUM HIRSUTUM* L. IN TURKEY (MODIFIED FROM THE *FLORA OF TURKEY* [DAVIS, 1967A])

- 1a. Median cauline leaves with glands at margins.  
 2a. Flowering stems of mature plants > 20 cm, ascending to erect.  
 3a. Median cauline leaves oblong-linear, 6–14 × 2–5 mm . . . *L. hirsutum* subsp. *anatolicum*  
 3b. Median cauline leaves oblong-spatulate, 14–27 × 5–12 mm . . . . .  
 . . . . . *L. hirsutum* subsp. *platyphyllum*  
 2b. Flowering stems of mature plants up to 10 cm, prostrate . . . . . *L. hirsutum* subsp. *oreocaricum*  
 1b. Median cauline leaves without glands at margins.  
 4a. Median cauline leaves > 8 mm long, flowers 7 to many.  
 5a. Plant suffruticose, median cauline leaves oblong-spatulate, attenuate near base . . . . . *L. hirsutum* subsp. *byzantinum*  
 5b. Plant herbaceous perennial, cauline leaves narrowly oblong to linear, not attenuate near base . . . . .  
 . . . . . *L. hirsutum* subsp. *pseudoanatolicum*  
 4b. Median cauline leaves up to 6 mm long, flowers 1 to 5 . . . *L. hirsutum* subsp. *bozdaghense*

*Specimens examined* (the following specimens voucher the map points in Fig. 2).

*Linum hirsutum* L. subsp. *anatolicum* (Boiss.) Hayek: TURKEY. **A2 Bilecik:** Yenişehir–Bilecik, Ö. Yılmaz s.n. (BULU 19930). **Bursa:** Uludağ, Soğukpınar, M. Başarman 3793 (ISTF). **A3 Bolu:** Düzce–Bolu, Ö. Yılmaz s.n. (BULU 26933); Eskipazar–Gerede, Ö. Yılmaz s.n. (BULU 24274). **A4 Çankırı:** Şabanözü–Eldivan, Ö. Yılmaz s.n. (BULU 27012). **Karabük:** Safranbolu–Eflani, Ö. Yılmaz s.n. (BULU 26952). **B2 Bilecik:** Pazaryeri–Bilecik, Ö. Yılmaz s.n. (BULU 19948). **Bursa:** Denizler–Keles, Ö. Yılmaz s.n. (BULU 19926); Keles, Ö. Yılmaz s.n. (BULU 11491). **B2 Denizli:** Babadağ, Ö. Yılmaz s.n. (BULU 24176). **Kütahya:** Domaniç, Ö. Yılmaz s.n. (BULU 19917). **B3 Eskişehir:** Sivrihisar–Polatlı, Ö. Yılmaz s.n. (BULU 26890). **B5 Kırşehir:** Kırşehir, Ö. Yılmaz s.n. (BULU 24242B). **Nevşehir:** Uçhisar, Ö. Yılmaz s.n. (BULU 24233). **B6 Sivas:** Hafik–Zara, Ö. Yılmaz s.n. (BULU 26985). **C2 Denizli:** Laodicea, 1842, *Boissier s.n.* (type K, digital image seen). **C4 Karaman:** Kırman–Büyükkora, Ö. Yılmaz s.n. (BULU 24221). **Konya:** Beyşehir–Konya, Ö. Yılmaz s.n. (BULU 24184).

*Linum hirsutum* L. subsp. *byzantinum* Azn.: TURKEY. **A1 Çanakkale:** Korudağ, Ö. Yılmaz s.n. (BULU 24162). **Kırklareli:** Kıyıköy–Vize, Ö. Yılmaz s.n. (BULU 26922). **Tekirdağ:** Keşan–Malkara, Ö. Yılmaz s.n. (BULU 24171).

**A2 (E) İstanbul:** Kemerburgaz–Çatalca, Ö. Yılmaz s.n. (BULU 26915).

*Linum hirsutum* L. subsp. *oreocaricum* P. H. Davis: TURKEY. **C2 Denizli:** Baba Da. above Kadiköy, *Davis 233* (holotype, K; isotype, E digital image seen).

*Linum hirsutum* L. subsp. *platyphyllum* (P. H. Davis) Yılmaz & Kaynak: TURKEY. **A2 Bilecik:** Bilecik–Bozöyük, Ö. Yılmaz s.n. (BULU 19946). **A2 Bursa:** Keschisch Da. (Ulu D.), *Bornmüller 4216* (holotype, K digital image seen). **Bursa:** Bursa–Keles, Ö. Yılmaz s.n. (BULU 11472). **A3 Adapazarı:** Taraklı–Geyve, Ö. Yılmaz s.n. (BULU 27018). **Bilecik:** Bozöyük–Bilecik, Ö. Yılmaz s.n. (BULU 26895). **B2 Kütahya:** Tavşanlı–Emet, Ö. Yılmaz s.n. (BULU 19952).

*Linum hirsutum* subsp. *pseudoanatolicum* P. H. Davis: TURKEY. **A4 Kastamonu:** Araç–İğdir, Ö. Yılmaz s.n. (BULU 24270). **A5 Çorum:** Havza–Merzifon, *Coode-Jones 1955* (ISTO). **B2 Bahkesir:** Simav–Demirci, Ö. Yılmaz s.n. (BULU 28989). **Denizli:** Kaplanlar–Çal, Ö. Yılmaz s.n. (BULU 28998). **Kütahya:** Domaniç, Ö. Yılmaz s.n. (BULU 11946). **B2 Afyon:** Bölme–Ulubey, Ö. Yılmaz s.n. (BULU 26887). **B3 Afyon:** Sandıklı, Ö. Yılmaz s.n. (BULU 19973). **Isparta:** Keçiborlu–Özbahçe, Ö. Yılmaz s.n. (BULU 19972). **B4 Ankara:** Ankara'nın 68 km güneyi, *H. Birand 2003*, *M. Zohary* (ANK). **Konya:** Ilgın–Kadınhanı, Ö. Yılmaz s.n. (BULU 24203). **B5 Aksaray:** Aksaray–Nevşehir, Ö. Yılmaz s.n. (BULU 24228). **Kırşehir:** Kırşehir–Mucur, Ö. Yılmaz s.n. (BULU 24245). **B6 Sivas:** Tokat–Sivas, Ö. Yılmaz s.n. (BULU 26980). **C2 Denizli:** Çardak–Çatlı, Ö. Yılmaz s.n. (BULU 28991). **C3 Antalya:** Korkuteli–Çavdır, Ö. Yılmaz s.n. (BULU 19967). **Isparta:** Gönen–Güneykent, Ö. Yılmaz s.n. (BULU 19970). **Konya:** Seydişehir–Beyşehir, Ö. Yılmaz s.n. (BULU 24180). **C4 Karaman:** Mut–Karaman, Ö. Yılmaz s.n. (BULU 13983). **Konya:** Ladik, *H. Birand 136* (ANK).

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#### Literature Cited

- Agnew, A. D. Q. 1980. *Linum* L. Pp. 274–288 in C. C. Townsend & E. Guest (editors), *Flora of Iraq*, Vol. 4. Ministry of Agriculture and Agrarian Reform, Republic of Iraq.
- Davis, P. H. 1957. Materials for a flora of Turkey: II. *Linum* L. Notes Roy. Bot. Gard. Edinburgh. 22: 135–161.
- . 1967a. *Linum* L. Pp. 425–450 in P. H. Davis (editor), *Flora of Turkey and the East Aegean Islands*, Vol. 2. Edinburgh University Press, Edinburgh.
- . 1967b. Materials for a flora of Turkey: XVI. Geraniaceae, Linaceae. Notes Roy. Bot. Gard. Edinburgh 28: 35–38.
- Greuter, W., H. M. Burdet & G. Long. 1989. *Linum* L. Pp. 216–226 in W. Greuter, H. M. Burdet & G. Long (editors), *Med-Checklist, Dicotyledones*, Vol. 4 (Lauraceae–Rhamnaceae). Conservatoire et Jardin Botaniques, Geneva.
- IUCN. 2001. IUCN Red List Categories and Criteria, Version 3.1. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland, and Cambridge, United Kingdom.
- Juzepzhuk, S. V. 1949. *Linum* L. P. 140 in B. K. Shishkin (editor), *Flora S.S.S.R.*, Vol. 14. Izdatel'stvo Akademi Nauk SSSR, Leningrad (in Russian).